Environmental Science and Policy 89 (2018) 231–246

Contents lists available at ScienceDirect

Environmental Science and Policy

journal homepage: www.elsevier.com/locate/envsci

Can social norm interventions promote voluntary pro environmental action?

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ARTICLE INFO

Keywords:
Climate change mitigation
Voluntary pro environmental behaviour
Carbon offsetting
Social norms
Online framing experiment

ABSTRACT

Conventional wisdom holds that voluntary pro-environmental action of citizens is desirable, but there remains much debate over how it could be promoted. We study this issue focusing on social norm interventions to increase voluntary carbon offsetting, which involves high personal costs. Specifically, we examine the causal effects of two types of social norm signals. One relates to attitudes and behaviour of other car owners (group information), the other to government policy on carbon offsetting, which carries an institutional signal of social desirability. While the former should have a positive effect, the latter could encourage or crowd out voluntary offsetting. Based on an experimental study design and a representative sample of 1919 car owners from the largest canton in Switzerland we find that, despite high costs, around 25% of our sample expressed a willingness to offset, and 11% actually paid to offset their emissions. The group norm intervention per se had little effect, but the combination of institutional and group norm signal caused a substantial increase in offsetting payment. Our study contributes to the discussion on how social norms and pro-environmental behaviour relate. The two main policy implications are that: (1) there is substantial room for using voluntary carbon offsetting to reduce emissions; and (2) institutional norm signals can promote voluntary carbon offsetting when pro-environmental behaviour is not yet widespread and group related norm interventions are thus difficult.

1. Introduction

The 2015 Paris Agreement seeks to keep the global mean temperature from rising by more than 1.5–2 °C above preindustrial levels. To reach this goal, both state-led and voluntary initiatives by stakeholders (e.g., individuals, firms, cities) are necessary to achieve the reductions of greenhouse gas emissions (GHG) required to that end. Individuals have a large array of options to voluntarily reduce their GHG emissions. One possibility is voluntary carbon offsetting, which means that individuals voluntarily pay for projects that reduce emissions elsewhere in order to compensate for their carbon footprint. For example, individuals could offset their emissions from air travel by paying for a carbon capture and storage or a reforestation project that reduces the amount of GHG emissions of their flights.

Carbon dioxide emissions in Switzerland are declining slower than needed to meet the ambition of the Paris Agreement according to the Swiss Federal Office for the Environment (Federal Office for the Environment 2018). A particularly worrisome sector is transport. Emissions from other sectors are decreasing, while emissions from transport, the highest emitting sector, remain constant. A substantial part of these emissions stem from individuals' car use, meaning there is considerable potential for GHG reductions. How could governments change individuals' behaviour to align better with overall societal goals, such as inducing individuals to voluntarily offset their emissions?

One way to influence individual behaviour is via social norms. Social norms are societal expectations concerning acceptable behaviour (Fehr and Fischbacher, 2004; Miller and Prentice, 1996; Schwartz and Howard, 1984; Thøgersen, 2006). The perception of societal norms affects how individuals behave. On the one hand, following a logic of consequentialism, individuals fear potential sanctions from their social environment should they violate social norms (see, for example, Fehr and Fischbacher, 2004). On the other hand, following a logic of appropriateness, individuals may follow social norms because it is the "right" thing to do in their perspective (March and Heath, 1994; March and Olsen, 2006; Weber et al., 2004).

Policy-makers, civil society, or other actors can seek to actively influence individuals' perceptions of social norms. We follow Tankard and Paluck (2016) and focus on two ways policy-makers and others can affect individuals' perception of social norms: group information and institutional signals. Group information signals to individuals what others in their respective social group (e.g., friends, family, colleagues, or in our case other car drivers) are doing. The social group is important as it informs individuals about the potential consequences of their behaviour, if they have to fear third party sanctions (Fehr and

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https://doi.org/10.1016/j.envsci.2018.07.016
Received 7 August 2017; Received in revised form 15 May 2018; Accepted 22 July 2018
Available online 21 August 2018
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Fischbacher, 2004), or the appropriateness of their action. In our case, a testimonial informs our survey participants about a car driver who believes voluntary carbon offsetting is desirable and that the person's social environment agrees. This treatment combines injunctive (what is ought to be done) and descriptive (what is done) normative information and should appeal to both rationales of norm compliance. The reference group here is not necessarily other car drivers. Rather, the treatment conveys a more general impression of what society thinks about this issue. We anticipate that this treatment increases an individual's intention to voluntarily offset carbon emissions as well as average payments for carbon offsets.

In contrast, institutional signals[1] refer to decisions by institutions that motivate individuals to infer what socially desirable behaviour is. In our case, our treatment informs individuals about Swiss legislation that requires importers of fossil fuels to compensate the resulting emissions from their imports. We argue that institutional signals may have positive or negative effects on individuals' pro-environmental behaviour. On the one hand, this treatment could signal social acceptance of voluntary offsetting, as it highlights that carbon emissions are problematic and offsetting is one mechanism to deal with them. On the other hand, individuals might perceive voluntary individual action as unnecessary as the government is already addressing the problem of carbon emissions. In line with Kallgren et al. (2000) and Cialdini et al. (1990), our treatments explicitly focus on the desired behaviour, in our case voluntary carbon offsetting.[2]

The importance of social norms for individual behaviour is virtually uncontested in social psychology and behavioural economics (Cialdini, 2003; Cialdini et al., 2006, 1990; Nolan et al., 2008; Tankard and Paluck, 2016; Thaler and Sunstein, 2008; Thøgersen, 2006). Concerning pro-environmental behaviour and more specifically voluntary carbon offsetting, Blasch and Farsi (2014), Blasch and Ohndorf (2015) and Schwirplies and Ziegler (2016) recently studied the effects of perceived social norms on stated behavioural intentions and stated previous voluntary carbon offsetting behaviour. According to this research, individuals who perceive carbon offsetting as a relevant social norm are more likely to have offset in the past, express preferences to offset in the future, exhibit a greater willingness to pay for offsetting, and use potential lottery wins from the survey to offset their emissions (Blasch and Farsi, 2014; Blasch and Ohndorf, 2015). Similarly, Schwirplies and Ziegler (2016) highlight that perceived social norms are specifically related to intentions to offset carbon emissions in the future, but not necessarily the intention to pay higher prices for green products. In other words, individuals who perceive a social norm that voluntarily offsetting carbon emissions is desirable and appropriate are more likely to hold positive preferences towards offsetting and are more willing to pay.

Our work adds to the current literature in several ways. First, we experimentally manipulate social norm perceptions concerning voluntary carbon offsetting. This allows for causal rather than only correlational inference. For example, Blasch and Farsi (2014) as well as Blasch and Ohndorf (2015) record participants' perception of social norms via survey questions, which only allows for correlational analysis.[3] Other research, such as Allcott and colleagues', manipulates norm perceptions but does not focus on voluntary carbon offsetting, which in our opinion represents a particularly tough test for the effects of social norms on pro-environmental behaviour, as it is quite costly without immediate personal rewards (Allcott, 2011; Allcott and Rogers, 2014).[4] Moreover, we examine different mechanisms of social norms perception (i.e., group information and institutional signals), unlike Allcott and colleagues who concentrate merely on group information. Additionally, the aforementioned studies only examine stated offsetting behaviour prior to the survey, whereas our study design allows us to observe participants' de facto offsetting payments (see, e.g. Blasch and Farsi, 2014; Blasch and Ohndorf, 2015).

To examine the effects of the aforementioned two mechanisms of social norm perception, we designed an online survey-embedded experiment focusing on voluntary carbon offsetting behaviour and randomly sampled 1919 car owners from the population of registered cars in the Canton of Zurich, the largest canton of Switzerland with a population of 1.5 million. We used a 2×2 design for the treatment conditions to study both types of social norm signals. First, individuals were randomly assigned to either receive the institutional signal or not, followed by random assignment to the group information treatment or not. Participants were thus assigned to one of four groups: a control group (control), a group that received the group information treatment (group information), a group that received an institutional signal treatment (institutional signal) and those who received both group information and an institutional signal (combined). After exposure to the treatments, we asked participants to offset the emissions from driving their car and provided them with an opportunity to do so. Therefore, we can assess both stated preferences and revealed offsetting behaviour (i.e., whether the participant paid for offsets).

Our results show that institutional signals have a significant positive effect on individuals' voluntary carbon offsetting behaviour, especially when the costs are low. The information on group behaviour has little or even a discouraging effect. The combination of these two treatments outperforms the control condition, regardless of suggested offsetting costs. The main policy implication of these results is that government-led environmental initiatives can stimulate additional voluntary pro-environmental action. In contrast, focusing on social norm interventions pertaining to peer group behaviour alone may have little effect, particularly in areas, such as voluntary carbon offsetting, where the respective pro-environmental behaviour is not yet very widespread.

In the remainder of the paper, we begin by discussing the literature on social norms and pro-environmental behaviour and presenting our theoretical argument, followed by the empirical study design. After that, we present our empirical results, discuss their policy implications, and highlight options for further research.

2. Concepts and theoretical arguments

In this section, we define key concepts, discuss how and why social norms affect pro-environmental behaviour, as well as which mechanisms policymakers can use to change social norm perceptions.

2.1. How and why do social norms affect behaviour?

Social norms act as blueprints for socially acceptable behaviour

[1] Institutions organise, educate or govern a certain group. For example, governments govern their citizens or school authorities educate students (Hogg and Reid, 2006; Silverblatt, 2004).

[2] Norms tend to affect behaviour more when they are directly connected to an imminent decision (Cialdini et al., 1990; Kallgren et al., 2000). These authors show, for example, that loosely related messages conveying social norms fail to increase compliance, while focused norm-conveying messages have a more substantial effect. This means, in their case, that littering behaviour will be affected more by information on recycling than by information on turning off the light (Cialdini et al., 1990, p. 1024). In other words, the relatedness of a norm to the behaviour matters. Therefore, our treatments are intentionally closely connected to voluntary offsetting behaviour.

[3] Blasch and Farsi (2014) as well as Blasch and Ohndorf (2015) use two questions to measure the perception of social norms. Participants are asked whether they think that a) their family and b) their friends expect them to offset their carbon emissions.

[4] Allcott and colleagues focus on the use of electricity consumption. This domain obviously holds private gains from pro-environmental behaviour, as the monthly costs for electricity decrease with increased pro-environmental behaviour.

within groups (Fehr and Fischbacher, 2004; Miller and Prentice, 1996). In other words, they are perceived social rules of appropriate behaviour. Individuals *comply* with these perceived social rules because of either one of two rationales.

First, social norms can affect behaviour via a logic of consequentialism. In other words, individuals follow rules because of a perceived social pressure to comply, and fear backlash from other group members or third parties if they fail to abide (Ajzen, 1991; Fehr and Fischbacher, 2004).

Second, individuals may follow a logic of appropriateness. In other words, they do not follow norms because they fear sanctions but rather because they think the respective behaviour is the correct way to behave in a given situation (March and Heath, 1994; March and Olsen, 2006; Weber et al., 2004). Individuals might also follow social norms because they signal how to act in uncertain situations.

What is perceived as appropriate or potential sanctions depends on an individual's respective group membership. Group memberships are not mutually exclusive, meaning that individuals can be members of several groups at the same time. For example, college students could be part of their class, as well as their friends at home, their family, or their country of origin. Each of these groups can be a reference group, and individuals will tend to follow whichever group's norms appear most salient at a given moment.

2.2. Social norm perception

How do individuals know what the social norm is for a given group? Individuals *perceive* social norms through three different mechanisms (Tankard and Paluck, 2016): a) key individuals and their endorsement of certain practices,[5] b) information on group behaviour, for example, via the media or observation of other group members' behaviour and c) institutional signals by groups or collective institutions, such as governments or political parties. For our study, we focus on social norm perception through group information and institutional norm signals and leave the social referents mechanism aside. The reason is that car owners are a very heterogeneous group, making it difficult to identify social referents that could uniformly appeal to all car owners.

The first mechanism of social norm perception on which we focus in this study is group information. If several group members behave in a certain way (e.g. engage in recycling), other group members will perceive this behaviour as socially desirable. This tacit feedback motivates them to adopt that behaviour as well. One can distinguish between two types of group information: a) descriptive and b) injunctive normative information. Descriptive normative information describes what other group members do (e.g. that they recycle), which is likely to trigger the logic of appropriateness. Injunctive information makes an explicit statement about an action that ought to be undertaken (e.g. one should recycle), which is likely to trigger the logic of consequentialism. Cialdini (2003, p. 105) refers to both types when claiming that, "[individuals] tend to do what is socially approved as well as what is popular".[6]

Individuals will follow these types of information for different reasons. They generally follow social norms because they fear sanctions or perceive the respective behaviour as appropriate. While these reasons are not mutually exclusive, injunctive norms highlight sanctions, as they hint at what would be considered a norm violation. Descriptive norms, on the other hand, highlight common behaviour, which might be more likely to trigger a logic of appropriateness, regardless of potential consequences. Alternatively, individuals may follow group information, since it signals the most effective behaviour in situations with substantial uncertainty.

Additionally, Cialdini et al. (2006) and Schultz et al. (2007) show that a combination of the two norm signals tends to have a stronger effect than either one in isolation. Individuals who receive both types of group norm information (injunctive and descriptive) are less likely to deviate from the respective group norm than individuals who encounter only one of the two messages (Schultz et al., 2007).

Given the policy focus of our paper, we combine the two types of group norm information (injunctive and descriptive) into a single positively toned experimental treatment condition. This treatment consists of a testimonial from someone who thinks voluntary carbon offsetting is the right thing to do (injunctive information) and describes that his social environment thinks so too, so that he offsets his carbon emission (descriptive information). We expect this group information treatment to positively affect individuals' willingness to offset their carbon emissions.

H1. On average, payment for voluntary carbon offsets is higher in the group information treatment condition than in the control group.

The second mechanism through which individuals perceive social norms is institutional signals. As mentioned earlier, institutions, such as governments, can send signals that may affect perceptions of social norms. This is not to say that institutions are exogenous from social norms, but rather that they are influenced by norms while at the same time acting as influencers of norms.[7] The effect of institutional signals occurs regardless of whether the underlying decisions are prescriptive (in the form of a law) (Sunstein, 1996) or a recommendation.[8]

Though it is widely expected that institutional signals have a positive effect on pro-environmental behaviour, it is, in principle, possible that institutional signals could crowd out voluntary pro-environmental behaviour. Individuals who learn about government action may reduce or refrain from voluntary pro-environmental behaviour because of a collective action problem. Individuals may freeride if they learn that other actors are already trying to solve the problem. In other words, institutional signals may crowd out voluntary behaviour because they allow individuals to obfuscate responsibility to be pro-environmental and infer that others are dealing with the problem already (Dodds et al., 2008). In our study, the institutional norm signal is that the Swiss federal government introduced a mandatory carbon offsetting requirement for fossil fuels importers.

[5] Tankard and Paluck (2016, p. 185) refer to key individuals as "social referents," who are widely known and salient among a specific group. Their endorsement increases awareness and acceptance of specific behaviour and signals an underlying social norm (see e.g. Hogg and Reid, 2006; Katz and Lazarsfeld, 2006). There are several techniques to identify key individuals (see e.g. Banerjee et al., 2014; Valente and Pumpuang, 2006). Most of these techniques use a) identification by group members, b) self-selection or c) long-lasting observation of the group (Valente and Pumpuang, 2006, pp. 883–884).

[6] It is interesting to note that descriptive norms may backfire if they conflict with injunctive norms. For example, Cialidini and colleagues (2006) found that a description of norm violation (e.g. many people steal) tends to increase norm violation (e.g. theft-rates), even if the injunctive norm forbids stealing. Thus, our descriptive and injunctive information explicitly target the same goal.

[7] Unlike in the case of social norm perception through group information, institutions can benefit from or suffer from their (prior) legitimacy. Democratically elected institutions, for example, gain credibility from their election process. Hence, they can function as a source of normative information if they are perceived as trustworthy (Hogg, 2010). That is, the extent to which an institutional normative signal encourages voluntary pro-environmental behaviour is likely to be moderated by the perceived legitimacy of the institution.

[8] The literature on social norm perception through institutional signals does not distinguish descriptive and injunctive signals. While the nature of the institutional signal suggests that its main effect stems from an injunctive component, they do not necessarily prescribe behaviour to the recipient of the institutional signal. When a law explicitly regulates a certain behaviour, it functions as an injunctive norm signal. If a related behaviour is regulated, as in our case, it has a mainly descriptive function. The difference between injunctive and descriptive norms might, however, matter for the reason of compliance. Laws explicitly formulate sanctions, while government recommendations do not. They also describe institutional action.

Whether the institutional norm signal of interest here has a positive, negative, or no effect is ultimately an empirical question.

H2. On average, payment for voluntary carbon offsets changes in the institutional signal treatment condition compared to the control group.

So far, we have argued that the group information treatment will have a positive effect on voluntary carbon offsetting behaviour, while the institutional signal could have a positive or negative effect. The combination of the two, however, may in principle outperform each treatment individually (for the 2 × 2 design, see Table 1). In theory, the effects of each treatment could be amplified but they could also cancel each other out.

Table 1
2 × 2 Design.

		Group Information	
		No	Yes
Institutional Signal	No	Control Group	Group Information (H1)
	Yes	Institutional Signal (H2)	Combined (H3)

Additionally, we expect that two treatments increase the likelihood that at least one of them positively affects pro-environmental behaviour. In fact, using different approaches to ensure the best policy result (i.e., "diversifying") is commonly discussed as a means to foster norm compliance (see e.g. Weaver, 2015). We thus hypothesise that:

H3. On average, payment for voluntary carbon offsets is higher in the combined treatment condition compared to both, the control group and each individual treatment.

Jointly examining group norm and institutional norm signals is important given the lively debates about voluntarism vs. government intervention in environmental policy-making (see, for example, Chernev and Blair, 2015; Malhotra et al., 2016; Potoski and Prakash, 2013). Whereas some observers and policy-makers favour voluntary action and are worried about crowding out effects of government intervention, others consider government as a positive force in fostering (complementary) voluntary pro-environment action among citizens. Focusing on the two types or mechanisms of norm signals can help resolving such debates.

3. Empirical design

3.1. Survey design

The survey starts by asking study participants (car owners) a series of demographic and other questions (age, gender, income, political ideology, and education) followed by a series of questions on their driving behaviour (i.e., kilometres driven per year, fuel type, and fuel consumption). We use some of this information later in the survey to estimate the cost of offsetting emissions from driving. Participants then read a brief description of voluntary carbon offsetting, and are then assigned to one of four treatment conditions/combinations. We intentionally asked individuals about their driving behaviour early in the survey to prime them to think about car owners as their social reference group. Participants randomly received the institutional norm treatment, followed by random assignment of the group information treatment, which emphasizes participants' membership in the car owner community (see Table 1). This results in four treatments groups: control (received neither treatment), those who received only the institutional norm treatment (institutional signal), those who received only the group information treatment (group information), and those who received both the institutional norm and the group information treatment (combined).

Comprehension check items for both treatments assess whether participants understood the content. More than 96% of the participants understood the institutional signal correctly, while more than 98% passed the comprehension check for the group information treatment.[9] We then provided participants with the opportunity to offset the carbon emissions from their most frequently used car over the last year (as mentioned above, the costs were calculated using information provided earlier in the survey). The survey concludes with questions on participants' perceived responsibility to act with regards to environmental degradation, climate change related knowledge, self-expressed interest in news on environmental and climate issues, climate change concern, and environmental concern. After the survey, participants who expressed interest in offsetting were subsequently sent an invoice by mail with the opportunity to offset their emissions from driving.[10]

3.2. Sampling strategy

In late 2015, the Canton of Zurich's car registry (Strassenverkehrsamt Zürich) drew a random sample of N = 10′000 from all car holders' registration identification numbers in the Canton and provided us with these persons' addresses. We then invited these individuals with a formal postal letter to participate in our online survey experiment. The survey was programmed in Qualtrics, and responses were recorded from 28 September 2016 to 25 January 2017. 293 postal invitations were undeliverable. Another 200 persons contacted us to decline the invitation because they lacked time or internet access. 2383 participants started the survey and 1919 participants fully completed it. Therefore, the response rate is approximately 20 percent, which is better than average when recruiting participants via postal invitations (Axhausen and Weis, 2010). The properties of our sample are summarized in the Appendix A (Tables A1-A2). We can assess the representativeness of the sample to some extent since we also have some, albeit limited information on the entire population of car owners in Zurich. Our sample is representative of the canton of Zurich car owner population in terms of gender, while it is slightly older (by one year) than the car owning population. We can thus draw inferences from our sample with respect to the entire population of car owners in the canton of Zurich, the biggest canton in Switzerland. The average car owner in our sample is 53 years old, male (38.8% of our participants are female), holds a university degree (49% of our participants hold a university degree) and earns more than the average inhabitant of the canton of Zurich (59.5% earn more than the average of 60.000 CHF per year).

We decided to implement our experiment in the Canton of Zurich for two reasons. Compared to other countries, Switzerland is an interesting case for studying pro-environmental behaviour since it is one of the most environmentally concerned countries (Franzen and Vogl, 2013). Given that Swiss citizens are very concerned already, Switzerland offers a hard test for theories on social norms, as they are already widespread and additional information is less likely to affect already held beliefs. Furthermore, Zurich is the largest city in Switzerland.

[9] For the institutional signal treatment, we asked participants "What is the carbon ordinance about?", with four different response options: (1) "Importers of fossil fuels have to offset carbon emissions from importing these fuels until 2020", (2) "Reduction of air pollution by industries outside Switzerland", (3) "Compensation of Swiss companies who pay for carbon taxes outside of Switzerland" or (4) "Don't know". For the group information treatment we asked participants "What is Martin's [Martin is the central person in the treatment] central statement?" and participants had four options to choose from: (1) "He thinks that carbon offsets are a good option to reduce carbon emissions. His friends already offset or think about doing so as well", (2) "He thinks carbon offsetting is a waste of money", (3) "He likes to drive his car and particularly around Zurich", (4) "Don't know".

[10] Table A5 and the corresponding section in the Appendix A contain information on the survey flow and the question wording for all used variables.

Table 2
Treatment Conditions.

Treatment Group	Treatment text
Control Group	-none-
Institutional Signal	In Switzerland, the government has already instituted mandatory compensation of CO2 emissions for fossil fuel importers, which also affects private car owners. **The carbon ordinance states that fossil fuel importers (i.e., importers of gasoline, diesel, natural gas) must compensate 10 percent of the CO2 emissions from the imported fossil fuels within Switzerland until 2020**. This means that fossil fuel importers must pay for projects that will reduce CO2 emissions elsewhere. Examples of such projects include renewable energy sources (district heating networks, heating with wood), fuels (e.g. biodiesel), energy efficiency and transport (e.g. transformation to electric and hybrid buses). These additional costs for fuel importers from these compensation projects will raise the costs of gasoline, diesel and gas at fuel stations in Switzerland by up to 5 Rappen per litre.
Group Information	My name is Martin and I live in the Canton of Zurich. I use my car regularly to drive to work, go grocery shopping and during my free time. I think it is okay to own a car and use it. However, I also know that driving releases CO2 emissions, which contribute to climate change. **Because of this, I decided to voluntarily compensate my CO2 emissions.** I feel personally responsible to compensate my CO2 emissions in order to protect the environment. **I think voluntary CO2 offsetting is a good idea and the right thing to do. When I discussed the issue with my friends, I learned that many of my friends are already voluntarily compensating their emissions to minimize the negative impact of driving on the environment, particularly the climate**. Many others are considering doing the same thing.
Both	-Institutional Signal and Group Information-

Note: The survey and the treatments are in German. The bold text also appeared in the treatments. For the original German wording, see the Appendix A (Table A3).

3.3. Treatments

We randomly assigned study participants to one of four treatment groups (see Table 2 for the treatment wording).[11] First, participants randomly received either the institutional signal or not. The institutional signal informs study participants that the Swiss government recently enacted a law obligating fossil fuel importers to compensate 10 percent of carbon emissions resulting from their imports from 2020 on (see Ordinance on the Reduction of CO2 Emissions SR 641.711).[12]

We then randomly assigned participants to the second treatment on group information, which presents the preferences of an average car owner in the Canton of Zurich. In a testimonial style, a person explains his positive stance towards voluntary carbon offsetting and reports that his social environment thinks similarly. Therefore, this treatment combines both injunctive normative statements and descriptive statements on his and her social environment's view. This 2 × 2 design allows us to compare the effects of the two treatments separately as well as the combination of the two (see Table 1).

3.4. Dependent variable

To measure voluntary carbon offsetting behaviour, we focused on behavioural intentions and actual behaviour, assuming that intentions in combination with capabilities tend to explain actual behaviour (Ajzen, 1991). We measured behavioural intentions using an ordinal scale. Participants were asked whether they a) wish to offset a fixed amount of their emissions (7.8% of respondents), b) are generally interested in offsetting (15.8% of respondents), or c) do not want to offset (76.4% of respondents). We refer to this dependent variable as INTENTION. For actual behaviour, we capture the actual offsetting payment in Swiss Francs, that is, the amount of Swiss Francs a person actually paid for offsetting her emissions.[13] We refer to this variable as BEHAVIOUR. Study participants who stated that they wished to offset or were generally interested in offsetting received an invoice to offset their emissions from driving in the previous year.[14] However, we did not force individuals to offset their emissions and allowed them to opt out if they preferred not to pay. Additionally, they could pay a different amount than suggested. We collected these payments and transferred them to our collaborator, myclimate.[15] Myclimate is a voluntary carbon offsetting provider based in Zurich, and is the largest and most prominent provider in Switzerland.

3.5. Methods

To estimate treatment effects on the dependent variable capturing actual offsetting behaviour (i.e., BEHAVIOUR), we use negative binomial regression, since this variable is heavily skewed (Direct Treatment Effects in Tables 3 and A6). Fig. 1 summarises the distribution of individuals' actual payments.[16] Generally, the vast majority of participants did not pay to offset their carbon emissions. The median suggested offsetting cost was 270 CHF. To estimate treatment effects on behavioural intentions we use multinomial logistic regression analysis (Intention models in Tables 3 and A6). Finally, to assess whether the treatment effects are driven by suggested offsetting costs, we include an interaction term between treatments and offsetting costs in a separate model (Treatment Effects Conditional on Costs in Tables 3 and A6).

All regression models include controls for gender, age, income, political ideology, suggested offsetting costs, and pre-survey contact with the research team.[17] Gender, age, income, and political ideology have been shown to affect pro-environmental behaviour (see e.g. Dunlap and McCright, 2008; Franzen and Meyer, 2010; Franzen and Vogl, 2013). The pre-survey contact control variable is interesting, because it may reflect social norms. Due to our sampling strategy, individuals experiencing trouble in accessing the survey either called or emailed our research team to ask for help. We recorded this contact and expect it to have a positive effect on offsetting behaviour. Individuals who relate to the research team, hear a voice or receive a personally written email, may evaluate the project and thus offsetting more positive.

Descriptive statistics of all used variables can be found in the Appendix A (see Table A1).[18]

As we are using multinomial logistic regression and negative binomial models, instead of coefficients we focus on predictions. This is

[11] See Table A4 for tests of the randomisation. The treatment allocation is not systematically correlated with individuals' a) probability to finish the survey, b) age, c) gender, d) political ideology and e) suggested offsetting costs.

[12] https://www.admin.ch/opc/en/classified-compilation/20120090/index.html

[13] At the moment of the study (January 2017), one Swiss Franc equalled 0.94 Euro and 1.00 US$.

[14] The formula is proprietary. Generally, emissions and respective costs are based on fuel type, fuel consumption and driven distance.

[15] www.myclimate.org

[16] The suggested offsetting costs were calculated using annual driving distance, fuel type, and fuel consumption. We used myclimate's formula to calculate the costs to offset one year of driving – the calculation was based on an owner's most frequently used car if she/he owned more than one car.

[17] The suggested offsetting costs are a function of annual driving, fuel type, and fuel consumption, which is why we excluded them from our set of control variables and only include costs.

[18] Note that due to missing values in the political ideology variable we lose another 137 cases. We rerun our models without political ideology and present the results in Figs. A1–A3 in the Appendix A. Substantially, all results remain stable.

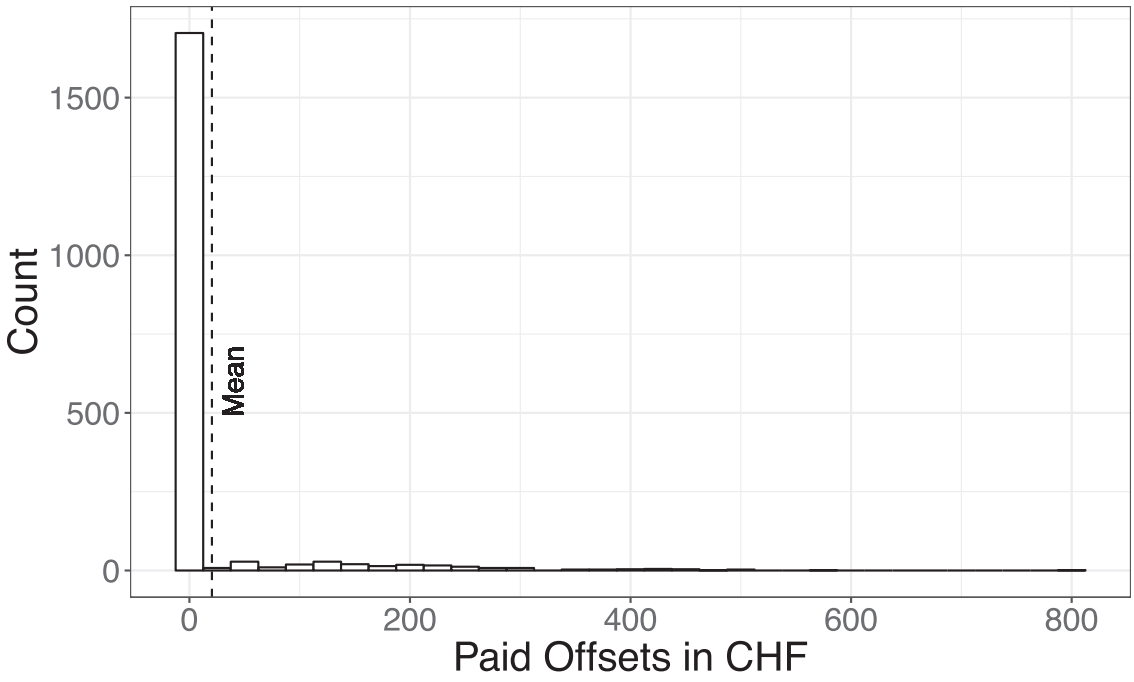

Fig. 1. Distribution of actual offsetting behaviour.
Note: The dashed line shows the mean (20.4 CHF) for all participants. (SD = 70.75, min = 0 CHF, max = 794 CHF).

necessary because the coefficient inform us about significance and sign but cannot be interpreted with regards to the quantity of interest (Swiss Francs paid).[19] To visualise the treatment effects we rely on simulations, as suggested by King et al. (2000). All Figures show predicted probabilities.[20],[21] We estimated the value inflation factors between variables in the analysis and found no signs of multicollinearity (see Table A7 in the Appendix A).

4. Results

To start with, Fig. 2 shows the predicted probability for each response option of the item for behavioural intention: (1) no interest in offsetting, (2) general interest in offsetting, (3) willingness to pay a fixed amount (i.e., INTENTION). We used a multinomial logistic regression to predict intention with 95% confidence intervals. We predicted the intention for female, university educated and average earning individuals, held at the mean in terms of left-right self-placement (5.2 on a 10-point scale), age (53 years) without pre-survey contact. Each range represents the predicted intention for one treatment (also see Table 3). We observe that a large majority of study participants showed no intention to offset their carbon emissions. More than three out of four participants did not wish to offset. Furthermore, we do not find any treatment effects, as the intention to offset carbon emissions is not significantly affected by treatment group. However, the negative and significant coefficient of suggested offsetting costs in both columns for general interest and offsetting a fixed amount (respectively vis-à-vis no intention to offset) (see Table 3) suggests that individuals who face higher suggested offsetting costs are substantially less likely to show offsetting intention.[22]

Now turning to actual offsetting BEHAVIOUR (Fig. 3, column 'Direct Treatment Effects' in Table 3), we find substantial treatment effects. Individuals in the group information condition on average paid less compared to the control group. This is indicated by the negative coefficient as well as by the predictions in Fig. 3. This is surprising as we anticipated a positive effect of this treatment (H1). The institutional signal does not differ from the control group. Again, this lends no support to H2, as we anticipated either positive or negative effects of the institutional signal. Finally, the combination of both treatments substantially outperforms the control group. For this group, the regression coefficient is statistically significant and positive and the predictions suggest an average increase in payment of about 4 CHF compared to the control group (H3). In line with the results for INTENTION, the suggested offsetting costs are negatively and significantly correlated with actual offsetting payments.

In order to better understand the somewhat surprising results, we reassess the treatment effects conditional on the suggested offsetting

[19] For the multinomial logistic regression, the predicted probability to belong to a given group is calculated using exponential functions of the coefficients. Therefore, these coefficients cannot be interpreted in the quantity of interest (Swiss Francs). In other words, a coefficient would indicate whether individuals as systematically more likely to show the intention to offset a fixed amount of carbon emissions vis-à-vis the reference (no intention to offset). For the negative binomial models, coefficients indicate the change in the expected value of the logged dependent variable. In other words, a negative coefficient for the group information treatment (which is -0.22 in Table 3 for the direct treatment effect model) would suggest that the logged expected payment decreases by approx. 20%. Given that we cannot directly interpret them in the quantity of interest (Swiss Francs), we use predicted values to interpret the treatments' magnitude in Swiss Francs.

[20] We used the statistical package R (R Core Team, 2015) for our analyses. Specifically, we made use of the following R-packages: *car* (Fox and Weisberg, 2011), *ggplot2* (Wickham, 2009), *ggthemes* (Arnold 2017), *htmlTABLE* (Boutaris and Zauchner, 2017), *MASS* and *nnet* (Venables and Ripley, 2002), *stargazer* (Hlavac, 2015) and *texreg* (Leifeld, 2013). Data and replication materials are available upon request

[21] In order to predict values, we rely on the effects package for the multinomial logistic regression (intention) and its predict function. For the negative binomial regression (behaviour), we created a new dataset and used R's internal predict function. We created a new prediction dataset which contains variation in terms of treatments and costs (in 50 steps between 0 and the 90% percentile (590 CHF)) and holds all other variables on their mean (Age and Left-Right Self-Placement) or on specific values for categorical variables ('university degree' for education, 'female' for gender, 'average' for income, and 'no pre survey contact' for pre survey contact).

[22] See Table A6 for the full regression results including control variables.

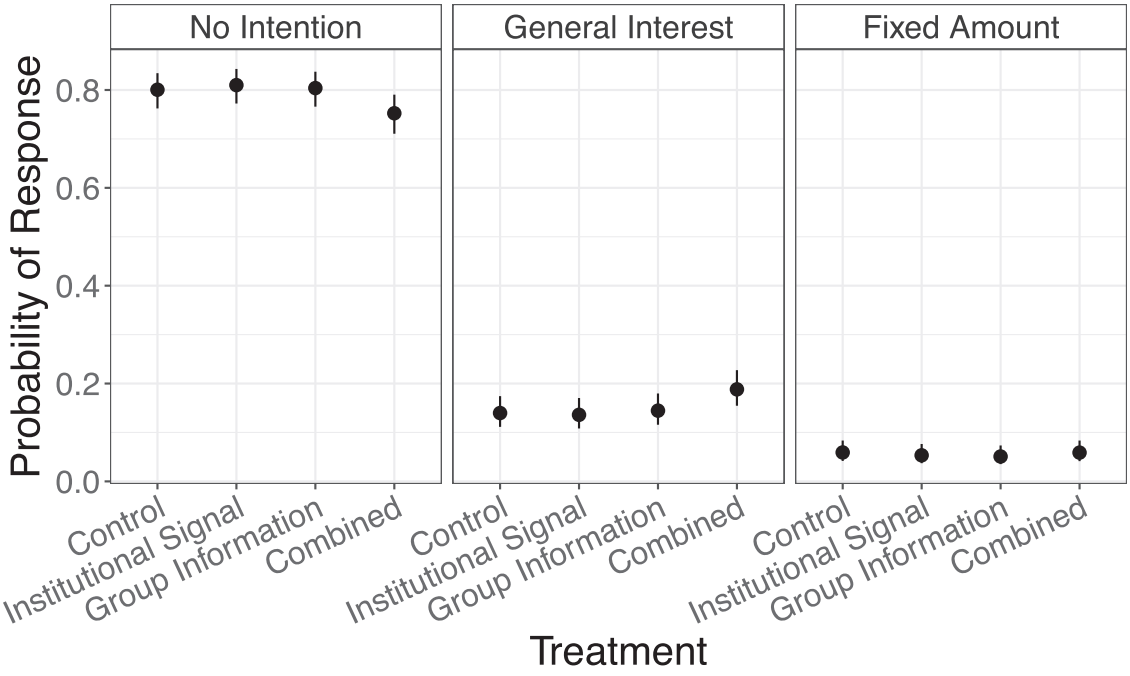

Fig. 2. Behavioural Intentions.
Note: The different ranges represent the 95% confidence interval. For coefficients see Table A6.

Table 3
Regression table.

	Intention		Behaviour	
	Fixed amount	General interest	Direct Treatment Effects	Treatment Effects Conditional on Costs
Combined Treatments	0.07 (0.25)	0.26 (0.19)	0.16 (0.01)***	0.39 (0.02)***
Group Information	−0.26 (0.26)	−0.03 (0.19)	−0.22 (0.02)***	−0.12 (0.02)***
Institutional Signal	−0.13 (0.25)	−0.13 (0.19)	−0.03 (0.01)	0.36 (0.02)***
Suggested Offsetting Costs	−0.00 (0.00)***	−0.00 (0.00)*	−0.00 (0.00)***	0.00 (0.00)***
Combined x Suggested Offsetting Costs				−0.00 (0.00)***
Group x Suggested Offsetting Costs				−0.00 (0.00)***
Institutional x Suggested Offsetting Costs				−0.00 (0.00)***

***p < 0.001, **p < 0.01, *p < 0.05. For the full regression table see Table A6 in the Appendix A.

costs. The suggested offsetting costs provided by myclimate are substantially higher than the carbon price in the current European Emissions Trading System, which was approximately 5 CHF per ton (myclimate's price is approximately 90 CHF per tonne for offsetting projects within Switzerland[23]) at the time of the experiment. Therefore, it seems plausible that the offsetting behaviour and the treatment effect are conditional on the costs an individual faces. We therefore use a negative binominal model with an interaction term of treatment and suggested offsetting costs (Table A6 in the Appendix A shows the regression table).

Fig. 4 shows the average predicted payment for BEHAVIOUR conditional on the treatment and suggested cost of offsetting (also see column 'Treatment Effects Conditional on Costs' in Table 3). We use the same prediction specifications as outlined above. In this setting, the control group on average pays approximately 25 CHF and increases as the cost of offsetting increases (see grey ribbon with dots in Fig. 4). The group information treatment has a negative effect on the average offsetting payment, compared to the control group, across predicted costs of offsetting (see blue ribbon with squares in Fig. 4). Individuals who received the group information treatment, on average pay approximately 5 CHF less than individuals in the control group. This gap widens as suggested offsetting costs increase. In line with the results shown in Fig. 3, we find no support for H1. The institutional signal has a positive effect on the average offsetting payment compared to the control group, when predicted suggested costs are less than 210 CHF, but has a negative effect for suggested offsetting costs above 320 CHF (see the yellow ribbon with triangles in Fig. 4). This explains why we found no treatment effect in Fig. 3. For a low level of suggested offsetting costs, our results indicate that individuals perceive an underlying social desirability of offsetting. However, when these individuals face high suggested offsetting costs, the treatment leads to a negative reaction, which decreases willingness to pay.[24]

The combined treatment is less sensitive to the suggested offsetting costs, and tends to significantly increase the average offsetting payment (see the green ribbon with crosses in Fig. 4). This corroborates H3. However, the effect decreases as the predicted cost of offsetting

[23] Myclimate does not offer full offsetting within Switzerland. Offsetting in Switzerland thus means that 50% of the emissions are offset in Switzerland, with the rest being offset in developing countries.

[24] Note that the discussed values are specific to the predictions. However, changes in the variables held at a constant level (such as age) cannot affect the shape of the relation due to the model specifications. Changing, for example, the age for the prediction should thus only affect predicted value, not the shape of the depicted relationship.

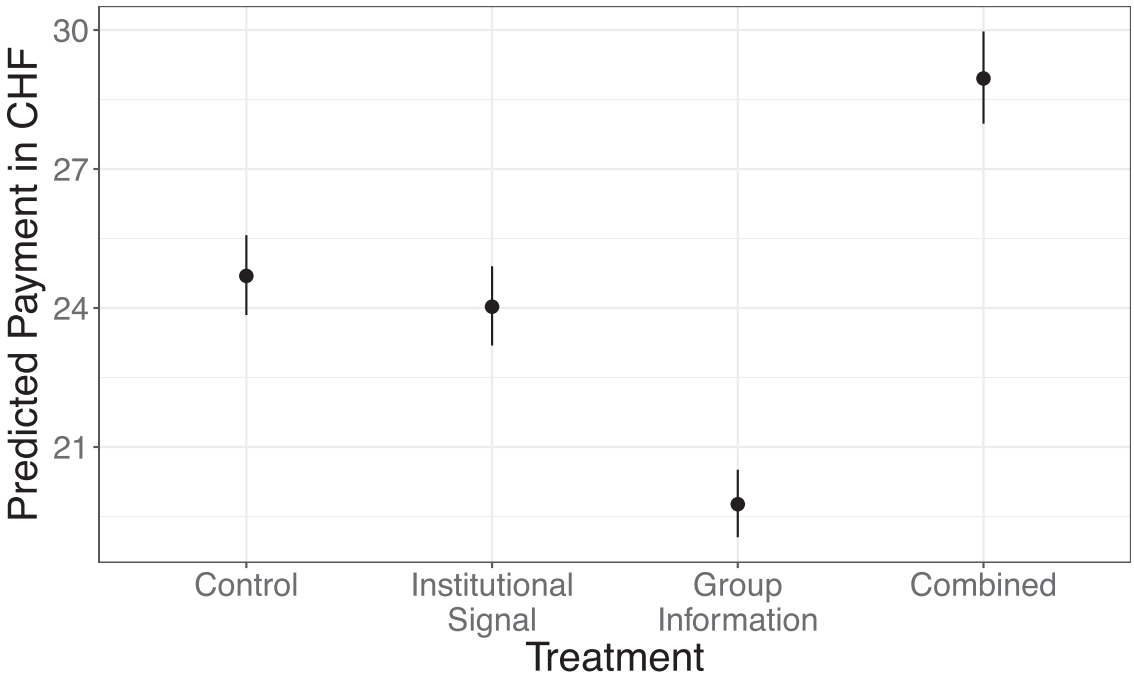

Fig. 3. Voluntary Carbon Offsetting Behaviour.
Note: The different ranges represent the 95% confidence intervals for each treatment. For coefficients see Table A6.

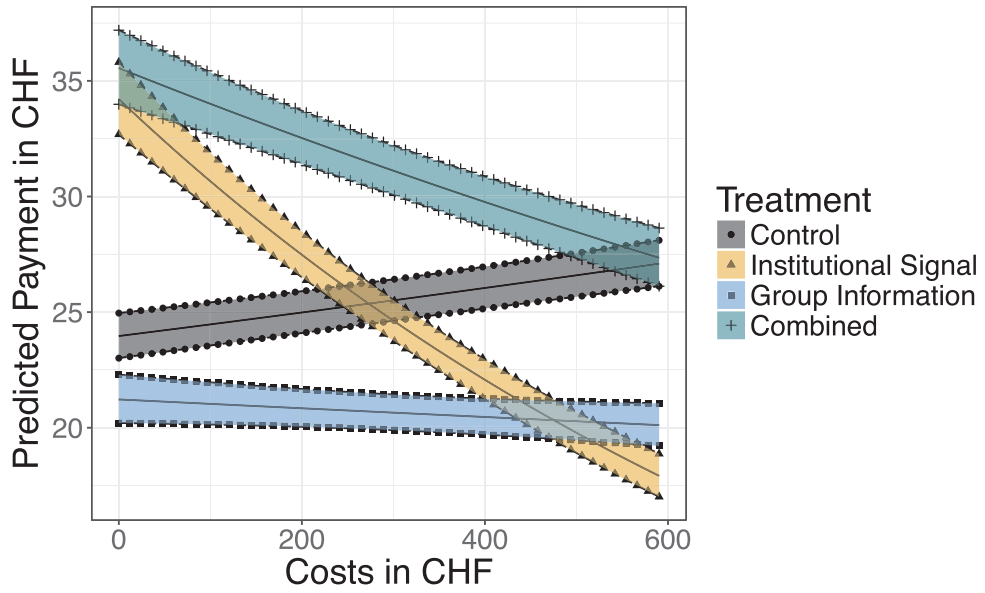

Fig. 4. Voluntary Carbon Offsetting Behaviour Conditional on Suggested Offsetting Costs.
Note: The different ribbons represent the 95% confidence intervals for each treatment. For coefficients see Table A6.

emissions increases.

The role of suggested offsetting costs substantially depends on the treatment condition, as some treatment conditions (institutional signal and the combined treatment) are very sensitive to cost increases, while other treatment conditions (group information and the control group) do not substantially react to changes in the suggested offsetting costs. Interestingly, pre-survey contact with the research team, another potential measure of social norms, is significantly and positively associated with voluntary carbon offsetting behaviour (see Table A6).

5. Discussion

In this paper, we examined the causal effect of two types of social norm interventions. We anticipated that positive information on other individuals' carbon offsetting behaviour would increase the average offsetting payment in this group compared to the control group (H1). We found little support for this hypothesis. Rather, individuals in this treatment condition on average paid less, especially when the suggested offsetting costs were high. This could be due to the fact that voluntary carbon offsetting among car owners in Switzerland (and also other countries) is still quite rare, which makes it difficult to convey a social group norm signal in a compelling way through a testimonial.

The finding for institutional norm signals is highly interesting in this context. We argued that institutional signals might have a positive or negative or even no effect on carbon offsetting behaviour (H2). Positive effects could relate to individuals' perception of social desirability if an

institution (in our case the Swiss government) encourages or even prescribes carbon offsetting. A negative effect could be due to crowding out the motivation to act voluntarily in view of already existing government action. We find evidence for both effects, conditional on the suggested offsetting costs. When these costs are low, we find support for a positive effect. When these costs are high, however, the effect is negative (H2). This suggests that government-led offsetting initiatives, rather than crowding out voluntary efforts across the board, could potentially foster more voluntary environmental action, perhaps precisely because individuals are in a setting where social group norm signals concerning carbon offsetting are still quite weak. The treatment condition that combines institutional signal and group information outperforms the control group. The average payment is highest in this combined treatment group, which corroborates H3. In line with our argumentation, this illustrates that a variety of interventions combined could help overcome potential hurdles and foster voluntary carbon offsetting.

Our results were obtained through a novel experimental approach. The empirical work is based on a random sample of 1919 car owners from the canton of Zurich, the largest canton in Switzerland. One new feature of our study design, compared to existing research, is that environmental behaviour is measured in terms of actual purchases of carbon offsets by our study participants, rather than via stated preferences or behavioural intentions measures, as is conventionally done. Another novelty is that we compare two distinct mechanisms of social norm perception. Compared to the usual group information treatment approach, our dual treatment approach seems more promising in our empirical case, as governmental action in our case may produce a more credible heuristic than information about group behaviour.

Our findings complement the existing literature in several ways. First, our results shed a different light on group information as a conveyor of social norms. Allcott and colleagues (Allcott, 2011; Allcott and Rogers, 2014), for example, find positive effects of group information on individuals' energy consumption behaviour in the USA. Potentially due to the rather low salience and prevalence of voluntary carbon offsetting, group information in our case has the opposite effect on this type of pro-environmental behaviour, while energy consumption and its consequences are better known to individuals. Furthermore, personal and societal benefits align in the realm of energy consumption (as lower consumption decreases individual costs), whereas these two types of benefits have an antagonistic relationship in the case of voluntary carbon offsetting.

Voluntary carbon offsetting, besides its practical relevance (which we discuss below), is of great theoretical interest because it involves very costly voluntary action, whereas many other forms of voluntary environmental action, such as recycling, are relatively cheap in terms of opportunity costs to citizens/consumers. By studying two mechanisms through which social norms can be signalled to those who can potentially engage in costly voluntary action, we can gain valuable insights into how civil society actors and other stakeholders as well as government could motivate to such action.

Furthermore, our findings are also relevant from a policy-perspective, as most areas of environmental policy are characterised by a combination of government-mandated top-down and voluntary bottom-up efforts, and lively debates over how voluntary action can be promoted and how it relates to government-led policy interventions. We contribute to this debate by studying whether and how social norm interventions could foster voluntary carbon offsetting among car owners. The relevance of carbon offsetting as a policy instrument derives from the fact that GHG emissions from individual car-based mobility show no sign of abatement, even in the most advanced industrialized countries where GHG emissions from most other sources are decreasing.

From a practical point of view, 11% of our study participants ended up buying carbon offsets, while 25% expressed a willingness to offset. In view of the high costs of offsetting (CHF 330 per year on average; equalled 330 US$ and 310 Euro), this result is in fact surprising. As noted further above, the unit costs of offsetting via myclimate are very high compared to the European Emissions Trading System carbon prices over the past few years. The costs of offsetting as well as the sensitivity of our treatment effects to suggested offsetting costs indicates that lower unit costs of offsetting could increase voluntary offsetting.

Our findings raise another interesting point, namely that in reality (that is, outside of our experiment), much less than 11% of car owners are offsetting their emissions, though we could not find any study confirming this estimate for Switzerland or the Canton of Zurich. Since we explicitly told our study participants that we have no prior view on whether carbon offsetting is desirable or not, this 11% share is unlikely to be inflated by social desirability bias. Rather, our study results suggest that, if all car owners knew of voluntary carbon offsetting, perhaps around 10%, and possibly more if unit costs of offsetting were considerably lower (and closer to the ETS carbon prices than offsets offered by myclimate), would engage in this voluntary pro-environmental action. By and large, the results are also in line with other work on stated pro-environmental preferences and behaviour. In the 2015 Swiss Mikrozensus on Mobility (Bundesamt für Statistik and Bundesamt für Raumentwicklung, 2017), for instance, 16% of individuals living in Switzerland favoured an increase of gasoline prices, and 22% supported congestion pricing in city centres. In line with this, more than 46% of our survey participants fully or rather agree that higher taxes on fossil fuels are appropriate to reduce carbon emissions from mobility, while a majority (almost 64%) fully or rather agree that the reduction of carbon emissions from transport should be reached through higher taxes on highly emitting cars.

One potential limitation of our study concerns representativeness, in the sense of whether we would have obtained the exact same results if socio-demographic and other distributions in our random sample had been the exact same ones as in the car owning population. While Table A2 shows that older individuals and diesel cars are slightly over-represented, we remain quite confident that our findings would hold beyond our sample as the deviation is rather small. While age might play a role in pro-environmental behaviour, the fuel type should not substantially affect how individuals are behaving. It is not possible to assess how representative our sample is with respect to other variables that were not provided by the car-registry alongside the addresses of car owners, e.g. education or income because we know those distributions for the general population, but not the car owning population specifically. To assess how sensitive our results are to changing conditions, we would have to carry out similar experiments again in the same canton of Switzerland, or other places.

Further research should also examine how group norms could be signalled in more compelling ways in circumstances where voluntary pro-environmental action is still quite rare. Yet another limitation of our research, which future studies could focus on, is that we did not test the effect of norm perception through key individuals (Tankard and Paluck, 2016). Given the widespread discussion on celebrities and their role in environmental action (see, for example, Prakash and Dolšak, 2017), this is an important potential mechanism that deserves more scholarly attention. In view of the sensitivity of treatment effects to suggested offsetting costs, further research should test this presumption through experimental variation of unit costs of offsetting. Finally, further research could also focus on how inviting survey participants to forward-looking offsetting (instead of offsetting of the past year's emissions, as in our study) could affect their behaviour.

Thus, the main policy implications of our findings are that: (1) there is substantial room for making greater use of voluntary carbon offsetting for reducing GHG emissions; and (2) government-led interventions can promote rather than crowd out voluntary pro-environmental behaviour, particularly in areas where such behaviour is not yet widespread and peer group related social norm interventions are thus difficult.

Acknowledgements

We are grateful to the comments and suggestions by two anonymous reviewers and the editors that have greatly improved this manuscript. We are grateful to Liam F. Beiser-McGrath, Sebastian Botzem, Kate Crosman, Ulrike Ehlert, Lukas Fesenfeld, Steffen Mohrenberg and Quynh Nguyen for their comments on previous versions of this article. We thank Dennis Atzenhofer, and Michael Hudecheck for their research assistance and myclimate, and the Strassenverkehrsamt Zürich for the cooperation throughout the data collection. The research for this article was funded by the ERC Advanced Grant 'Sources of Legitimacy in Global Environmental Governance' (Grant: 295456) and supported by ETH Zürich.

Appendix A

1.1. Descriptive Statistics

Table A1
Descriptive Statistics.

Variable	Definition	N	Mean	St. Dev.	Min	Max
Behaviour	Actual payments to offset carbon emissions in Swiss Francs	2,383	14.050	59.688	0.000	794.000
Intention	Intention to offset in the Survey					
Fixed Amount		2,018	0.077	0.267	0	1
General Interest		2,018	0.158	0.364	0	1
No		2,018	0.765	0.424	0	1
Treatment	Random assignment to one of four groups					
Control		2,063	0.252	0.434	0	1
Group		2,063	0.256	0.436	0	1
Institutional Signal		2,063	0.248	0.432	0	1
Combined		2,063	0.244	0.430	0	1
Suggested Offsetting Costs	Suggested costs to offset last years' emissions in Swiss Francs	2,118	335.104	281.267	0	4,576
Education	Participants' education, recoded to four groups.					
Minimum Education		2,242	0.019	0.136	0	1
Apprenticeship		2,242	0.400	0.490	0	1
Higher Edu. Entrance		2,242	0.091	0.288	0	1
University Degree		2,242	0.490	0.500	0	1
Female	Participants' gender	2,369	0.388	0.487	0	1
Age	Participants' age	2,369	52.962	15.051	16	90
Left-right Scale	Participants' political ideology	2,056	5.164	1.925	0	10
Income	Participants' response whether their income is below, close to or above the average income of 5000					
Above	CHF per month.	2,257	0.595	0.491	0	1
Average		2,257	0.189	0.391	0	1
Below		2,257	0.166	0.372	0	1
Don't know & No Resp.		2,257	0.008	0.091	0	1
Pre Survey Contact	1 if participants called us to ask for help with the survey	2,383	0.025	0.157	0	1

Note: Bold names in the variable column refer to variable names, non-bold names show levels. For example, for intention, the level fixed amount summarises the information of this subgroup of intention Representativeness.

1.2. Representativeness

We ran *t*-tests and equal proportion tests in order to assess the sample quality. Table A2 summarises the results. Our sample is representative with regards to gender, but differences between fuel types and age are statistically significant.

Table A2
Representativeness.

Variable	Sample Characteristic	Population Characteristic	Test	Sign.
Birthyear	1962.90 (mean)	1964.23 (mean)	T-Test	***
Gender	Female = 732 (38.1%) Male = 1187 (61.9%)	Female = 180,957 (36.8%) Male = 310,497 (63.2%)	Equal Proportion Test	n.s.
Fuel type – Gasoline	Gasoline = 1350 (70.3%) Other = 563 (29.7%)	Gasoline = 359,093 (73.3%) Other = 130,532 (26.7%)	Equal Proportion Test	***
Fuel Type - Diesel	Diesel = 552 (28.8%) Other = 1361 (71.2%)	Diesel = 121,470 (24.8%) Other = 368,155 (75.2%)	Equal Proportion Test	***

Note: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$, n.s. $p > 0.1$.

Table A3
German Treatment Text.

Treatment	GermanWording
Institutional Signal	In der Schweiz gibt es bereits heute eine staatlich verordnete Kompensation von CO2-Emissionen, die auch private Autobesitzer betrifft. **Die CO2-Verordnung schreibt vor, dass Importeure fossiler Treibstoffe (Benzin, Diesel, Erdgas) bis ins Jahr 2020 10 % der CO2-Emissionen aus dem Verkehr innerhalb der Schweiz kompensieren müssen.** Dies heisst: Sie müssen Projekte finanzieren, die 10 % der CO2-Emissionen aus dem Verkehr in der Schweiz anderweitig reduzieren. Beispiele sind Projekte in den Bereichen erneuerbare Energien (z.B. Fernwärme, Wärmeproduktion mit Holz) und Treibstoffe (z.B. Biodiesel), Energieeffizienz und Transport (z.B. Umstellung auf Elektro- oder Hybridbusse). Die Kosten dieser Kompensationsprojekte, die zusätzlich bei den Treibstoff-Importeuren anfallen, werden die Kosten von Benzin, Diesel und Erdgas an Tankstellen in der Schweiz um bis zu 5 Rappen pro Liter erhöhen.
Group Information	"Ich bin Martin und lebe im Kanton Zürich. Mein Auto benutze ich regelmässig um zur Arbeit zu fahren, einzukaufen sowie in meiner Freizeit. Ich denke, es ist absolut in Ordnung, ein Auto zu besitzen und zu fahren. Gleichzeitig weiss ich, dass Autofahren CO2-Emissionen verursacht und dass ich damit zum Klimawandel beitrage. **Aus diesem Grund habe ich mich entschieden meine CO2-Emissionen freiwillig zu kompensieren.** Ich fühle mich persönlich dafür verantwortlich, meine CO2-Emissionen zu begrenzen und damit zum Umweltschutz beizutragen. **Daher glaube ich, dass freiwillige CO2-Kompensation eine gute Sache ist und ich damit das Richtige tue. Als ich das Thema mit Freunden diskutiert habe, wurde mir bewusst, dass viele meiner Freunde ihre CO2-Emissionen bereits freiwillig kompensieren, um den negativen Einfluss ihres Autofahrens auf die Umwelt und insbesondere das Klima zu minimieren.** Viele andere überlegen, ob sie dasselbe tun sollten."

1.3. Treatments

Table A4 shows that there is no systematic relationship between treatment allocation and several central variables. In other words, the randomisation of treatments worked satisfactorily.

Table A4
Validation of Randomisation.

	Finished	Age	Gender	Political Ideology	Suggested Offsetting Costs
Intercept	2.46*	52.99*	0.40*	5.20*	347.01*
	(0.16)	(0.69)	(0.09)	(0.09)	(11709)
Combined Treatments	0.05	0.23	0.10	−0.07	−21.71
	(0.23)	(0.99)	(0.13)	(0.13)	(16.68)
Group Information	0.07	0.02	0.17	−0.02	−13.29
	(0.23)	(0.97)	(0.13)	(0.13)	(16.50)
Institutional Signal	0.47	0.22	0.06	−0.15	−20.34
	(0.26)	(0.98)	(0.13)	(0.13)	(16.62)
AIC	1048.30		2557.55		
BIC	1070.83		2579.79		
Log Likelihood	−520.15		−1274.78		
Num. obs.	2063	1919	1919	1783	1918
Adj. R2		−0.00		−0.00	−0.00

Note: *p < 0.05.

1.4. Survey

The here presented survey only includes questions that were used in the analysis. We maintained the order of the questions.
Q1 Please indicate your gender

- Male
- Female

Q2 Please tell us your year of birth:
[textfield]
Q3 The average income in Switzerland per capita and year is 60'000 francs (around 5'000 per month per capita, including wages, interest and social security). Would you tell us whether your personal income lies below, at the same level, or above this value?

- Below the average
- At the average
- Above the average

Table A5
Summary of the survey flow.

Section of survey	Function
Demographics & Personal Information	Collecting covariates for analysis and information for sample tests
Mobility Behaviour	Estimating carbon emissions
Knowledge of & information on carbon offsetting	Providing information on offsetting to guarantee a certain level of knowledge.
Institutional Signal	Randomly assigned to individuals; Treatment
Group Information	Randomly assigned to individuals; Treatment
Offsetting Procedure	Records information on behavioural intention
Views on offsetting	Collection of covariates for the analysis
Stances on climate change & environmental concern	Collection of covariates for the analysis
Policy preferences to limit carbon emissions from transport	Collection of covariates for the analysis

- Don't know
- No answer

Q4 What is the highest level of education that you have completed?

- Obligatory schooling
- Apprenticeship
- Professional maturity certificate
- High school degree
- University of applied sciences degree
- University degree

Q5 In political matters, people talk of "the left" and "the right". How would you place your views on this scale?
0 (Left) to 10 (Right); DK

Q6 How many thousand kilometers (km) do you approximately drive by car in one year? If you do not know the exact distance, please give your best estimate.
[textfield]

Q7 Which fuel type does your car use?

- Gasoline
- Diesel
- Biogas
- Fossil gas (LPG/CNG)
- Hybrid

[Skip if Q7 is not "Hybrid"] **Q8** Which fuel type does your hybrid use?
[INSTRUCTION: Save information as fueltype, Save unit "litre" for gasoline and diesel and "kilogram" for biogas and fossil gas]

- Gasoline
- Diesel
- Biogas
- Fossil gas (LPG Liquefied Petroleum Gas? /CNG compressed natural gas?)

Q9 How much [fueltype] does your car use per 100 km on average?

- [textfield]
- I don't know

[Skip if Q9 is not "I don't know"] **Q10** Which car type relates to your car the most?

- Compact car (approx. 5 units per 100 km)
- Mid-size car (approx. 8 units per 100 km)
- Minibus (approx. 12 units per 100 km)
- SUV/off-roader (approx. 14 units per 100 km)

Treatment 1:

In Switzerland, the government has already instituted mandatory compensation of CO2 emissions for fossil fuel importers, which also affects private car owners. **The carbon ordinance states that fossil fuel importers (i.e., importers of gasoline, diesel, natural gas) must compensate 10 percent of the CO2 emissions from the imported fossil fuels within Switzerland until 2020**. This means that fossil fuel importers must pay for projects that will reduce CO2 emissions elsewhere. Examples of such projects include renewable energy sources (district heating networks, heating with wood), fuels (e.g. biodiesel), energy efficiency and transport (e.g. transformation to electric and hybrid buses). These additional costs for fuel importers from these compensation projects will raise the costs of gasoline, diesel and gas at fuel stations in Switzerland by up to 5 Rappen per litre.

[Comprehension Check Treatment 1] **Q11** What is the content of the new CO2 ordinance?

- Importers of fossil fuels have to compensate for 10% of CO2 emissions caused by the transportation using their fuel in Switzerland
- Reducing industry-based air pollution outside of Switzerland.
- Compensating importers for the taxation of CO2 emissions outside of Switzerland.
- Don´t know

Treatment 2:

Please read the following statement by a person living in the canton of Zurich: "My name is Martin and I live in the Canton of Zurich. I use my car regularly to drive to work, go grocery shopping and during my free time. I think it is okay to own a car and use it. However, I also know that driving releases CO2 emissions, which contribute to climate change. **Because of this, I decided to voluntarily compensate my CO2 emissions.** I feel personally responsible to compensate my CO2 emissions in order to protect the environment. **I think voluntary CO2 offsetting is a good idea and the right thing to do. When I discussed the issue with my friends, I learned that many of my friends are already voluntarily compensating their emissions to minimize the negative impact of driving on the environment, particularly the climate**. Many others are considering doing the same thing."

[Comprehension Check Treatment 2] **Q12** What is Martin's central message?

- He thinks CO2 compensation is a good opportunity to limit his CO2 emissions. His friends are already compensating or are considering a compensation.
- He thinks CO2 compensation is a waste of money.
- He likes driving his car and he especially likes the roads around Zurich.
- I don´t know.

Response Page Dependent Variable: Using the information you previously gave about your car, your yearly CO2 emissions caused through driving with this car can be estimated. The emissions accumulate to approximately [X] tons CO2. Click here for more information on the calculation. These calculations are based on the car calculator of myclimate. myclimate is the biggest supplier of CO2 compensations in Switzerland. The car calculator of myclimate computes the CO2 emissions due to driving a car. This includes not only direct emissions due to the combustion of fuel, but also so-called grey emissions. These emissions occur in the production of the car, through the provision of transportation infrastructure as well as during the production process (extraction, transportation, refining) of crude oil. As mentioned earlier, you can compensate your emissions. Instead of reducing your CO2 emissions by less driving or driving a more efficient vehicle, you would finance a project which aims at reducing or avoiding CO2 emissions. We would like to ask you now whether you would be interested in fully or partially compensating your CO2 emissions with myclimate, the biggest supplier of CO2 compensations in Switzerland. At least half of your emissions would be reduced within Switzerland. The remaining portion would be reduced by supporting climate protection projects in least developed and developing countries.

Based on the calculations by myclimate, a complete and effective compensation of the yearly emissions produced by your [X] car would cost a one-time payment of [X] francs.

Please keep in mind that we as scientists do not have any commercial relation to myclimate and we also do not promote any particular opinion on CO2 compensation. We selected myclimate because it is the biggest and most famous supplier of effective CO2 compensations in Switzerland.

We will ask you below whether you want to compensate the CO2 emissions caused by your car. Please complete the survey regardless of whether you want to compensate or not. Your decision will not have an influence on your participation in the lottery that was described in the letter.

Q13 Please read all possible answers from the following list carefully before you decide for one answer.

- I do not want to compensate for my CO2 emissions.
- Generally, I am interested in compensating my CO2 emissions. Please send me an invoice. I will decide within the next two weeks, whether and how much I want to compensate.
- I want to compensate a portion of my total CO2 emissions of the previous year. I will specify the portion in the next question [0–100% in 10% steps]. Please send me an invoice.
- I want to compensate my CO2 emissions in full. This would relate to [X] tons of carbon emission and the complete compensation is [X] francs. Please send me an invoice.

1.5. Regression Table

Table A6 provides the full regression results presented in Table 3.

Table A6
Regression Results.

	Intention		Behaviour	
	Fixed amount	General interest	Direct Treatment Effects	Treatment Effects Conditional on Costs
(Intercept)	−2.64 (0.56)***	0.33 (0.38)	2.70 (0.03)***	2.62 (0.03)***
Combined Treatments	0.07 (0.25)	0.26 (0.19)	0.16 (0.01)***	0.39 (0.02)***
Group Information	−0.26 (0.26)	−0.03 (0.19)	−0.22 (0.02)***	−0.12 (0.02)***
Institutional Signal	−0.13 (0.25)	−0.13 (0.19)	−0.03 (0.01)	0.36 (0.02)***
Suggested Offsetting Costs	−0.00 (0.00)***	−0.00 (0.00)*	−0.00 (0.00)***	0.00 (0.00)***
Gender (Female = 1)	0.15 (0.20)	−0.30 (0.14)*	−0.18 (0.01)***	−0.17 (0.01)***
Education - Higher Eduation Entrence	0.48 (0.41)	0.67 (0.24)**	0.32 (0.02)***	0.36 (0.02)***
Education - Minimum	−11.39 (0.00)***	−0.20 (0.77)	−39.34 (13,993,165.45)	−39.34 (15,005,998.18)
Education - University Degree	1.15 (0.23)***	0.55 (0.16)***	0.88 (0.01)***	0.89 (0.01)***
Left-Right Self-Placement	−0.23 (0.05)***	−0.25 (0.04)***	−0.14 (0.00)***	−0.14 (0.00)***
Income - Average	−0.24 (0.26)	−0.45 (0.20)*	−0.29 (0.02)***	−0.29 (0.02)***
Income - Below	−0.62 (0.31)*	−0.29 (0.20)	−0.30 (0.02)***	−0.30 (0.02)***
Income - Don't Know	0.77 (0.83)	0.59 (0.71)	0.43 (0.05)***	0.50 (0.05)***
Income - No Response	−10.63 (0.00)***	−0.24 (0.43)	−1.22 (0.06)***	−1.11 (0.06)***
Age	0.03 (0.01)***	−0.01 (0.00)*	0.01 (0.00)***	0.01 (0.00)***
Pre Survey Contact	−0.00 (0.51)	−0.30 (0.50)	0.08 (0.03)*	0.09 (0.03)**
Combined x Suggested Offsetting Costs				−0.00 (0.00)***
Group x Suggested Offsetting Costs				−0.00 (0.00)***
Institutional x Suggested Offsetting Costs				−0.00 (0.00)***
AIC	2367.35	2367.35	174224.67	168324.86
BIC	2542.89	2542.89	174319.06	168434.57
Log Likelihood	−1151.68	−1151.68	−87095.33	−84142.43
Num. obs.	1782	1782	1906	1782

Note: ***p < 0.001, **p < 0.01, *p < 0.05.

1.6. Robustness Checks and Additional Information

Due to missing values in the political ideology variable, we lose 137 respondents. In order to assess whether our results are sensitive to including these individuals, we drop political ideology for the models below (see Figs. A1–A3). Substantially, the results do not change. Additionally, we tested for multicollinearity (see Table A7), however, found no unusual value inflation factors.

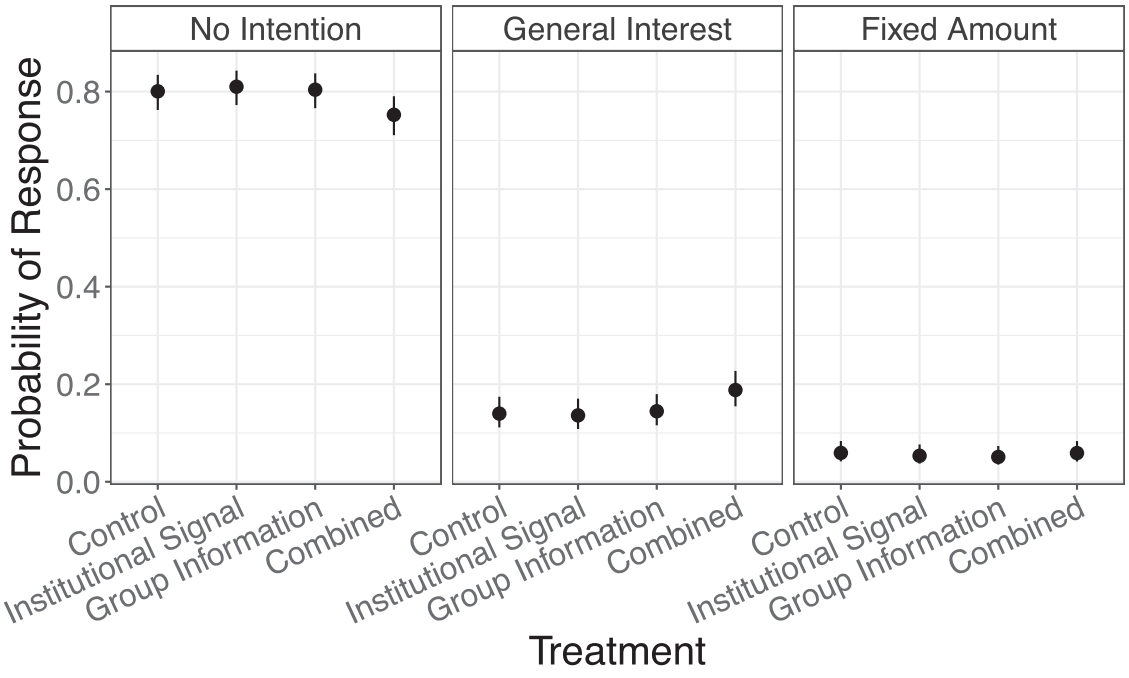

Fig. A1. Behavioural Intentions.
Note: The different ranges represent the 95% confidence interval.

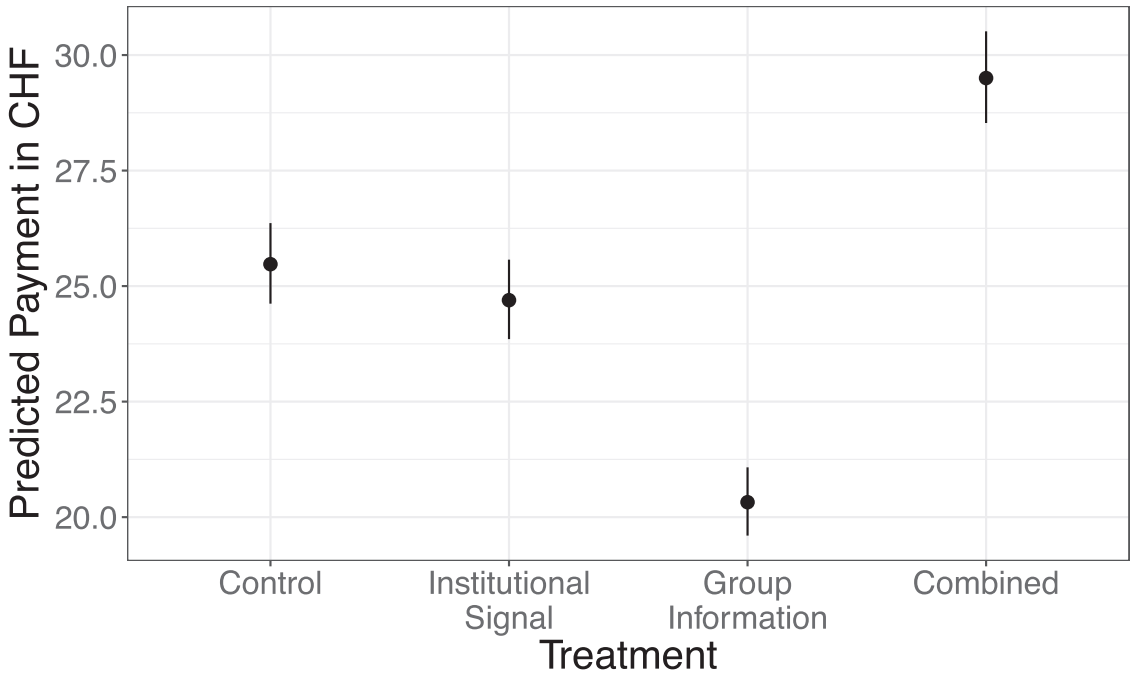

Fig. A2. Voluntary Carbon Offsetting Behaviour.
Note: The different ranges represent the 95% confidence interval.

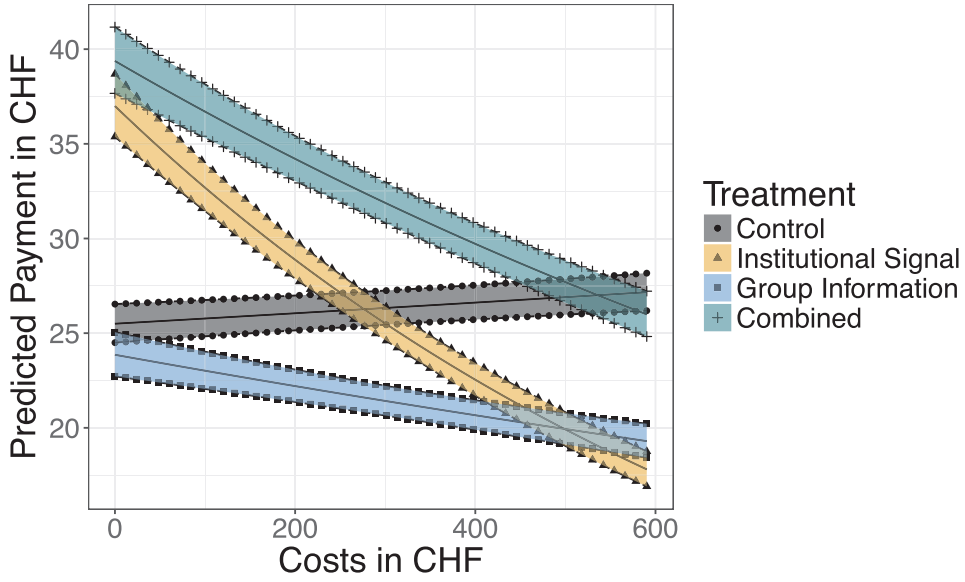

Fig. A3. Voluntary Carbon Offsetting Behaviour by Costs.
Note: The different ribbons represent the 95% confidence interval.

Table A7
Multicollinearity Tests.

	Intention: No	Intention: General interest	Intention: Fixed amount	Behaviour: Direct Treatment Effect	Behaviour: Treatment Effect Conditional on Costs
Treatment	1.859	1.769	1.956	1.003	1.704
Suggested Offsetting Costs	1.884	1.955	1.636	1.039	1.384
Education	1.021	1.022	1.022	1.053	1.019
Age	1.048	1.036	1.068	1.018	1.047
Gender (ref = Female)	1.055	1.05	1.054	1.03	1.05
Left-Right Self-Placement	1.021	1.022	1.02	1.017	1.029
Income	1.012	1.009	1.014	1.05	1.018
Pre Survey Contact	1.021	1.021	1.032	1.012	1.015
Treatment x Suggested Offsetting Costs	2.033	1.973	2.046		1.775

Note: Entries represent Variance Inflation Factors (VIF) values based on Fox and Monette (1992). In order to estimate the VIF for intention, we used logistic regressions for each response category of the variable, which is equivalent to a multinomial regression's output per response category.

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